DOCUMENT RESUME

ED 336 356 SP 033 261

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TITLE Classroom Action Research: A Professional Development Opportunity for Experienced Teachers. Draft.
PUB DATE 7 Apr 91
NOTE 23p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, April 3-7, 1991).
PUB TYPE Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Action Research; Collegiality; *Educational Environment; Elementary Secondary Education; Faculty Development; Inservice Teacher Education; Outcomes of Education; Program Evaluation; *Programing Languages; *Teacher Role; Teaching Experience
IDENTIFIERS Experienced Teachers; *LOGO Programing Language; *Teacher Researchers

ABSTRACT

The purpose of this study was to develop methodologies to support experienced teachers in taking on the role of participant researchers and engaging in collaborative inquiry through action research projects about their teaching practices. Although the structures designed were not content-specific, the teachers in the study were using the LOGO computer language in their teaching, and their research questions involved the teaching and/or learning of LOGO. The collaboration was at 2 levels: among the approximately 10 teacher researchers at each of 9 sites over 7 states who met regularly throughout one school year; and among the sites, through a leadership institute, mailings, telecommunications network, and phone calls. The project, the LOGO Action Research Collaborative, was developed to extend the professional responsibilities, voices, and insights of experienced teachers and to provide a context for professional renewal. In the pilot research cycles, it has been observed that the project provides professional nourishment and collegiality for experienced teachers, that teachers gain new understandings about the LOGO content they are teaching, that teachers make self-directed improvements in their classroom teaching practices, and that teachers take on new roles as researchers and research group leaders. Sixty-six references are included. (IAH)

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Classroom Action Research: A Professional Development Opportunity for Experienced Teachers

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Presented at the Annual Meeting
American Educational Research Association
April 7, 1991, Chicago Illinois

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"...A development critical to education in our time is the building of a professional culture in schools... Involved in that restructuring is ... a new set of relationships between and among all members of the school community, including an enlargement of the leadership team in schools, new roles for teachers and ... and even a rethinking of the substance of what is to be taught... New roles for teachers are appearing--and without the support and learning needed for success in these new positions..." Ann Lieberman, Building Professional Culture in Schools

This work is part of a growing national agenda for creating a more professional culture among educators and new roles for classroom teachers. The purpose of this study was to develop methodologies to support experienced teachers in taking on the role of participant researchers and engaging in collaborative inquiry through action research projects about their teaching practices. The structures designed were not content-specific. However, the teachers in this study were all using the Logo computer language in their teaching; their research questions involved the teaching and/or learning of Logo. The collaboration among teachers was at two levels. The first was among the approximately ten teacher researchers at each of nine sites over seven states who met regularly throughout one school year. The second was among the sites, supported by the project directors at Education Development Center (EDC) through a leadership institute, mailings, telecommunications network and phone calls. The project was developed partially to extend the professional responsibilities, voices and insights of experienced teachers and partially to provide a context for professional renewal. The methodologies developed enabled teachers to study some aspect of their practice and experience a sense of mutual support by sharing real concerns and using tools of research for reflection, revision, improvement and/or interpretation of their work. This paper will describe the project, its sources and some of the benefits for teachers.

Antecedents to this Study: Developing Professional Communities Through Classroom Research

The Ideas which informed this study evolved through participation in projects over a twenty-year period. The challenge to expand teachers' professional roles and create structures for ongoing nourishment has been proposed by national studies (Carnegie,

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1986; Holmes Group, 1986; Loucks-Horsley, et. al, 1987). As practitioners committed to improving schooling and participating in collaborative dialogue about practice, we sought out contexts which were wellsprings of both professional renewal and reform. Several of these provided opportunities for teachers to take on the role of participant researchers who met in ongoing collegial groups and supported each other's inquiries over extended periods of time.

Bill and Sara Hull of Cambridge, Massachusetts, developed the Children's Thinking Seminars (Hull, 1979) in the early seventies, and invited outstanding teachers from the Boston area to attend regular seminar meetings. Their agenda was to ask teachers to describe specific instances of children's thinking. Participants were expected to -- and often did -- write descriptions which were shared among the group. The group collaborated through conversation, written Notes and Commentary, and later through the Children's Thinking Network Newsletter in moving ever deeper into the description of learning and the discrepancies between what was taught and learned (Watt, M. 1979). Participants experienced the seminars as professionally nourishing and some teachers maintained their participation over several years.

Patricia Carini of the Prospect Center in North Bennington, Vermont, developed methodologies to support teachers in collaborating on phenomenological research. For example, she and her colleagues developed and shared structured ways to reflect on the meaning of a word or an example of a child's work. One research format called Staff Review of the Child focused the teachers' inquiry towards illuminating the whole person by looking for motifs and themes used in writing, art or play. Another format supported a group in looking at a whole teaching practice in response to the presenting teacher's description of the context and focusing question. These methodologies provided formal structures which allowed participants to move from evaluation to reflective understanding (Carini, 1975, 1979, 1982).

Ralph Mosher of Boston University, led a group of teacher researchers in the Brookline Public Schools in defining, evolving and documenting their own democratic classroom practices. Teachers collaborated to develop documentation methodologies which were as natural and as unobtrusive as possible while permitting them to fulfill their primary responsibilities as teachers. They shared all aspects of carrying out research projects over the course of a year. Teachers wrote research reports for inclusion in the book, Democratic Classrooms (Lickona, in press; Lickona, Mosher and Paradise, 1979, Watt, M., in press).

Jeanne Bamberger, Eleanor Duckworth and Magdalene Lampert, of the Division for Study and Research in Education at M.I.T., conducted An Experiment in Teacher Development (Bamberger, et al, 1981). Their project provided opportunities for teachers to engage in and reflect on challenging learning experiences at their own levels. Participants subsequently documented and reflected on the learning of their students, when faced with similar challenges.

Other work derived from these sources, included the Teacher Initiated Research Project (Evans, et al, 1981) which has since become the Educators Forum at the Harvard Graduate School of Education. The Educators Forum supported classroom research through a series of after school meetings taking place over years. At the meetings, participants described and talked over their puzzlements and inquiries. This led to new understandings and was often the impetus for improving teaching. Teachers in Philadelphia established the Teachers Learning Collaborative (TLC), which met year after year, using methodologies developed at the Prospect Center. TLC teachers continue

to take responsibility for their own facilitation and support. This engagement provides professional sustenance and a deepening of their understandings of practice (Philadelphia Teachers Learning Collaborative, 1984; Cochran-Smith and Lytle, 1990).

The Educational Foundations Masters Program for experienced, practicing teachers at Antioch/New England Graduate School of Education in Keene, New Hampshire, encourages participants to use action research to develop their masters projects. The faculty expects teachers in the program to examine and improve their teaching practices in the light of current educational theories. Participants meet and take courses throughout the year with a cluster of colleagues who live nearby, and are supported by individual faculty advisors.

Almost all the initiators of the above, including the principal investigators of this study, participated in the annual meetings of the North Dakota Study Group on Evaluation. Since 1972, this small national network of educators has worked to create new ways of knowing and documenting learning as prerequisite to educational reform (Cochran-Smith and Lytle, 1990; North Dakota Study Group). Several of the projects described are affiliated with the Classroom Action Research Network (CARN) housed at the University of East Anglia, England. This an international network links university researchers and classroom teachers in undertaking practical studies to improve schools (Somekh, 1986; Somekh, et al, 1989; Owens and Edwards, 1989). The principal investigators serve on its steering committee and coordinate the New England Network of CARN.

Action research by classroom teachers has been more common in Great Britain and Australia than in the United States. These approaches were originally developed by Kurt Lewin (1946, 1948) as a systematic way for groups of people directly effected by planned social changes to take responsibility for an ongoing cycle of planning those changes and systematically evaluating their effects. (Kemmis and McTaggart 1988a, 1988b) of Deakin University in Australia have thoroughly articulated its use in education. To them, action research implies systematic inquiry by collaborative, self-critical communities of classroom teachers, to improve their own educational practices. It involves a process of identifying an area for investigation, and gathering information, followed by a recursive spiral of planning, acting, observing and reflecting (Kemmis and McTaggart, 1988a).

All of the above have many common characteristics by which they support classroom research, nourish professional communities of educators, and support them in the development of their teaching. These include:

• Teachers are respected as capable professionals, who, through taking a disciplined look, can understand and resolve subtle issues about learning cultures and their own classrooms.

• Students are respected as unique individuals with names, dignity, interests and human worth; they are not regarded as "subjects" of study.

• Specific instances of a teacher's or a student's learning are used as a focus for looking.

• Methodologies are used which encourage reflection, documentation and/or description.

• Some require writing; all require structured collaborative conversations, facilitated according to specific ground rules.

• Participants are invited to take on a research frame of mind towards puzzles and dissonances of their practices.

• Collaborations persists over time; some over the course of one year, some over many years.

• Teachers develop collegial relationships with each other, rather than take on roles as students or subordinates, even when the group is facilitated by a university researcher or school official.

• Research is demystified; qualitative studies are designed and carried out by the participants in response to their own problem formulations.

• Findings are shared and may be used to inform and change any group member's practice; larger dissemination is not usually mandated, but may be facilitated.

Participants in these activities report feeling nourished by a professional culture -- rather than finding these collaborations to be add-ons to already too full professional lives. Some find new voices of personal authority which become a source of authentic empowerment. They are able to create practices responsive to the needs of their students in a manner which is grounded in their methodologies. And they can take well-grounded stands for practices which they have documented as beneficial for themselves and their students.

We have adopted the strategies and terminology of action research for our own work, rather than simply teacher research, as it evokes professionally appropriate ways for teachers to take control of and responsibility for their own professional decisions. When teachers take on the role of researchers and document their practices, they begin to identify changes that could improve the learning environment for their students. Action research provides the imperative for them to implement those changes and methods for assessing the results.

Questions about teaching and learning with Logo

Logo teaching and learning is rich with opportunities for action research because of discrepancies between the visions of Logo's developers, and the achievement of students using Logo in everyday classrooms. In the 1970s, M.I.T. Professor Seymour Papert and his colleagues set out to create a computer-based learning environment that would simultaneously foster the learning of important concepts of mathematics, computer science and generalizable problem-solving strategies. Papert believed that this environment could transform the learning of mathematics from the formal procedures for memorizing algorithms he observed in most schools to a constructivist approach (Papert, 1971; 1980).

When Logo was introduced into schools in the early 1980s as a vehicle for learning with and about computers, its widespread application was followed by controversy and unanswered questions (Moursund, 1983; Tetenbaum and Mulkeen, 1984). A variety of studies have attempted to measure what students gain from learning Logo, with mixed results (Clements, 1985). Typical of early Logo studies were those conducted at the Bank Street College of Education, which attempted to determine whether students who had worked with Logo would demonstrate any improvement on external measures of

problem-solving skills. The most general conclusion drawn by Bank Street researchers was that learning experiences with Logo, in and of themselves, did not lead to evidence of transfer to non-Logo activities such as planning to carry out a series of chores (see for example, Pea, 1983; Pea and Kurland, 1984; Pea, Kurland and Hawkins, 1987).

Clements (1985), assessing the results of 40 early Logo studies, asserted that the results, although not conclusive, indicated that " . . . Logo does appear to offer significant educational advantages." A limitation of some of the studies Clements reviewed was that they included very little description of what students actually did in their Logo activities, did not document students' learning based on what they accomplished in the classroom, and ignored or downplayed the importance of the teachers' own Logo knowledge and the content and pedagogy used in teaching. There seemed to be an unspoken assumption among researchers conducting many experimental or quasi-experimental studies, that "Logo" was some kind of "treatment" for which effects could be measured. In contrast, our own assumption was that Logo allowed for many different kinds of learning, and as in other aspects of education, outcomes would vary significantly with the teachers' knowledge, experience, teaching approaches and objectives and the students' own project interests.

Other Logo research has included more descriptive studies which tend to involve small numbers of students and give more background about the learning context, the specific teaching objectives, and the methods used in particular settings, than experimental studies. They tend to focus on students' learning in some detail, and while they show that Logo-using students do engage in mathematical problem-solving behaviors, they also reveal specific difficulties students experience in using Logo effectively. (Papert, et. al., 1979, Watt D. 1979a, 1979b; Kull, 1984; Hillel, 1984; Hoyles, 1985; Noss, 1985; Hillel and Samurcay, 1985; Leron, 1983,1985; Watt, M. 1986; Weir, 1987). A number of Logo studies have also focused on specific teaching strategies and interventions (Klahr and Carver, 1987; Kinzer, Littlefield, Delclos and Bransford, 1985).

However, more questions remained than had been answered about effective Logo learning and teaching strategies. As Logo learning environments (software programs and applications) expanded to include computer animation, word processing, robotics and cybernetics, the learning possibilities have multiplied. The culture for supporting effective teaching and learning with Logo must continue to develop, providing both need and opportunities for teachers to deepen their understandings and improve their teaching practices.

A major incentive for establishing the Logo Action Research Collaborative came directly from teachers in the course of our work interpreting Logo through lectures, classroom visits, and Logo workshops in the early 1980s. Teachers frequently asked: "Is there any research I can cite to convince my school board (principal, superintendent, math supervisor, parents, ...) that Logo is valuable for students? I'm convinced that my students are learning important things, but I don't know how to convince the school board." We turned the question back to them: "What are <u>your</u> Logo students learning, and how do you know?" Despite strong convictions about Logo's worth, based on their students' work and pride in accomplishments, teachers were apt to be vague in their answers. They frequently expressed an interest or need to become more knowledgeable and articulate about what they felt to be the benefits of Logo experiences for their students beyond the obvious and insufficient observation that students liked it.

Papert's vision of Logo as an open-ended environment in which learners are largely responsible for their own learning requires that the learners have teachers who understand important aspects of Logo learning. The teachers need to possess a collection of ways to challenge students' curiosity, support student project development and probe student understanding (Watt M. 1982; Watt and Watt, 1986). The kind of professional teacher needed for effective Logo teaching - and possibly any teaching - begins to approximate what Donald Schon (1983, 1987) has labeled a reflective practitioner. A number of observers have commented on the importance of the Logo teacher's role (Moursund, 1983; Leron, 1983, 1985; Watt, D. 1982; Watt, M. 1982; Watt and Watt, 1986). It is disturbing to note, however, that only a handful of research papers have focused directly on teachers' roles in supporting Logo learning (Carmichael, et al, 1984; Hawkins, 1985; Burnett and Higginson, 1984; Stavely, Watt and Watt, 1986; Watt, Watt and Stavely, 1986).

The Logo Institute, a summer immersion program, was an attempt to build a professional Logo culture among teachers. It was conducted at Keene State College, Union College and Lesley College Graduate Schools from 1984 to 1989 and provided an environment for Logo-using educators to deepen their knowledge of Logo by project development at their own level (Stavely, Watt and Watt, 1986; Watt, Watt and Stavely, 1986). Although the experiences at the Institute provided opportunities for teachers -- as students -- to reflect on their own learning, several key ingredients of reflective practice were missing. For instance, although teachers developed implementation plans, there were no opportunities after the Institute to support participants while they applied what they had learned to their teaching. There was no opportunity during the Institute to assess their children's Logo programs as a part of developing a reflective teaching practice. Teachers were not invited to bring portfolios of student projects created using Logo to discuss, assess and describe until 1988.

Description of the Logo Action Research Collaborative

The Logo Action Research Collaborative (LARC) was established in 1986 to support teachers using Logo in building professional cultures. It's purpose is to support experienced teachers to

- critically examine their practices
- engage in collegial reflection and dialogue
- increase their content knowledge of Logo
- develop methods for assessing student learning
- carry-out an action research project
- revise, improve or develop their teaching practices
- develop more authoritative professional voices
- participate in peer support to research by colleagues

The purpose of our work was to develop and disseminate the materials, approaches and methodologies for local leaders' use in leading action research collaboratives with a Logo focus. We anticipate that most of these approaches and materials can be adapted to other domains of learning.

The Logo Action Research Collaborative supported a series of collaborative research meetings conducted over a school year. The first pilot cycle included nine teachers in 1986-87. The second pilot cycle included eight teachers in 1989-90. During the first two pilot cycles, we developed a set of materials and activities to support the carrying out of action research activities with a focus on Logo Learning. During 1990-91, we disseminated these materials to ninety teachers at nine national sites where school

district personnel led collaborative action research groups with teachers in their own districts.

The first step in the development was an NSF-supported classroom research project, Exploratory Research on Critical Aspects of Logo Learning: A Collaborative Project with Teachers as Observers. We defined "critical aspects of Logo learning," as knowledge, skills and understandings in problem-solving, mathematics, and computer science, which are essential for effective learning of Logo, and are typically not discovered by students in isolation. Learning them often requires timely intervention by teachers and supportive classroom environments. One of the outcomes of the critical aspects research was a method for supporting action research (Watt and Watt, 1988). Another was a description of critical aspects of Logo learning, fleshed out with examples of student work gathered by participating teachers (Watt and Watt, in press).

During the 1989-90 school year we worked with a group of teacher researchers (representing grades 4 - 8) from Boston, Brookline and Concord Massachusetts. During 1990-91 the project expanded to involve nine different school districts representing all grade levels - preschool - high school. Groups of teacher researchers in Boston, Brookline and Concord, Massachusetts were led by past project participants. Six additional groups were led by experienced Logo teachers and teacher educators in Bellevue, Washington; Brattleboro, Vermont; Chapel Hill, North Carolina; Chicago, Illinois; Ladue, Missouri; and Madison, Wisconsin. Group leaders from all nine districts attended a one-week leadership institute at Education Development Center in Newton, Massachusetts.

The methods developed in this study for supporting action research established a one-year cycle of fourteen after-school meetings with three overlapping phases. The first phase, Looking At -- roughly four sessions -- was devoted to developing and practicing common ways of seeing and speaking. During the second phase, Asking About -- about six sessions -- teachers formulated their problems and designed their research plans. The third phase, Finding Out -- approximately four sessions -- provides the synthesis through data analysis, report writing and the sharing of findings.

Each phase has its own methods, processes and structures to support the work. The facilitating leader of each research collaborative determines which are used and how adapted to the particular group's work. Some examples of these follow.

Support Structures for the Looking At Phase

We learned that a fruitful way to get started is to ask each teacher to choose two students to follow with regular documentation and data collection. This documentation may include portfolios of Logo programming projects, augmented by students' notes, sketches and journal entries, as well as a teacher's notes and observations of working sessions. Teachers are asked to choose one student because of their own particular interest or curiosity about the student or a desire to understand the student better. The second student is chosen to represent different qualities or characteristics. For example, if the first student is female, the second should be male. If the first is a reluctant student, the second might be chosen for eagerness. If the first loves Logo programming, the second might be chosen for resistance. The choice and reasons are the teacher's.

There are many reasons for having participants engage in this activity. This type of observation allows participants to begin doing research in a small, non-threatening way. As the observations proceed, research issues begin to arise such as confidentiality,

participant observation, who owns the data, and how it gets organized. Teachers learn to base their observations in specific data, rather than on generalizations. This data becomes a focus for looking together and developing a common language, before designing a formal research project. Discrepancies between teaching and learning confront teachers early and may provide a focus for their problem formulation and research design. The process allows trust to develop among group members as they confront real issues and dissonances.

Another structure used during the first phase is a collaborative learning challenge: a difficult Logo programming problem which thrusts participants into the role of learners at their own level. Teachers are asked to create a collaborative "Logo quilt" made up of several squares, each of which has its own design. We intentionally interrupt the programming after an hour's work, so that participants can share what they have accomplished up to that point, and reflect on their own learning. This begins an ongoing process of identifying some of the key components of the knowledge and processes which are involved in Logo programming. Participants brainstorm lists of the actual knowledge used in constructing their programs. Knowledge is listed under headings such as problem-solving strategies, mathematics and computer science, aesthetics and cooperative learning strategies. Next steps include looking at the knowledge that wasn't used, but which might have been useful. By participating in these discussions, teachers review their knowledge of Logo, learn new mathematical content, programming skills and problem solving strategies from each other, and start developing a common language for describing Logo learning. At the end of the session, we introduce the list of critical aspects of Logo, developed in our first pilot. Participants are invited to use the list and modify it throughout the rest of the project (Watt and Watt, in press).

Other structures for supporting collaborative inquiry during the Looking At phase, include:

- Group reflections on key words such "research" and "Logo"
- Pairs programming a symbol representing Logo's meaning
- Peer sharing and editing written descriptions of teaching contexts
- Participation in a process called "What Knowledge is Kathy Using?" for assessing student examples (see description below)

Support Structures for the <u>Asking About</u> Phase

During the Asking About phase, teachers find, define and refine their own research questions and identify ways to gather data that will work with their teaching approaches. Then they begin to gather data and attempt to make sense of it through preliminary data analyses. Support for this work requires skillful listening and facilitation by group leaders. This is a fragile time for teacher researchers. During this phase there are many tentative starts, some of which may transform into more focused studies; others may change entirely before a research focus is definitely chosen. Problem shifts are appropriate for this phase of the process. We recommend that teacher researchers search for a particular issue or concern which is compelling enough to them personally, to justify the many hours studying it.

The agendas for meetings during phase II are responsive to the specific work of the participants. The structures used during this phase support teachers in group inquiry and analysis of the specific data they are gathering, yet are open-ended enough to allow new questions to arise. Simultaneously, rather than sequentially, the group leaders facilitate the participants through the process of planning their research, and carrying

out their research plan. Some leaders visit their participants in their individual classrooms during this time. The conversations that follow a classroom visit seem to be especially fruitful in helping teachers converge on a specific research question and issue.

A process called "What Knowledge is Kathy Using?" introduced during phase I using samples of student work provided by the leader, is continued during phase II, using data provided by participants. The work is presented through a formal reflective process, in which the leader or a group member serves as chair. The student's work is copied and distributed to each group member. The chair introduces the focus for the presenting teacher, identifying the concern of the teacher in bringing the particular student and/or example to the group. This background information is presented in ways that are descriptive rather than evaluative. One general criterion for the presentation is that the student whose work is presented and her parents should be able to be in the room and feel comfortable with the description.

Participants study the examples of the student's work, then offer their responses to the question, "What knowledge did this student use?" Each contribution is written on a share sheet without evaluation or discussion. The process is done methodically, with time taken to clarify the wording of each description. Often headings may emerge, but an undifferentiated list permits a later sorting and may be preferable.

In the second step of this process participants respond to the question, "What potentially relevant or useful knowledge is this student not using at this point in her work?" They are encouraged to consider the way the student is working and what she might be trying to do? After a lengthy list is generated, the third question is asked: "If you were the teacher, what one intervention might you take? How? and Why?" Once again, each participant's suggestions are heard and recorded -- but not evaluated.

No discussion is permitted, although clarifying questions may be asked. The presenting teacher is asked to listen to the ideas offered by colleagues, but not to evaluate them or report on whether or not she has tried them previously. The chair or a volunteer compiles a list of all ideas offered and duplicates copies for each to keep. It is the presenting teacher's responsibility to take the list home and make her own professional decisions as to which, if any, of the ideas she will integrate into her own practice. Teachers often report about what has happened at later meetings, and bring in new examples of the student's work in progress.

This process provides participants with a simple and straightforward way to share alternatives for assessing student learning and teaching strategies which have been useful to them. Many teachers report that this is a powerful experience for them. Supporting another teacher's problem forces participants to move outside their own contexts and beyond their own methods to solve the problem. They hear the teaching ideas of others, with descriptions of why and how to implement them, and they are entirely responsible for deciding whether or not to adapt to their own classrooms. If some of the mathematics or Logo programming ideas are new or not understood by a participant, time is taken by the group to explain them when the formal process is complete.

Another process used during this phase is a brainstorming, "What is Data?" People think of as many potential data sources as possible and the leader lists them on blackboards or share sheets. Then the leader supports participants in looking back and evaluating them to see if each can be justified as data. We define data as evidence which is physical. For example, a conversation is not data unless notes are taken, or it is

recorded or transcribed. Notes on this process are distributed to all participants and are valuable in terms of identifying the data sources for their own research designs.

Other support structures for the Asking About phase include a Focusing Question Process and an Action Research Planner:

• The Focusing Question Process is used throughout the project to help the group support an individual to clarify an issue, define a research question, or receive suggestions about a particular problem. The format and ground rules are similar to those used for What Knowledge is Kathy Using?

• The Action Research Planner is a printed form, first used when a participant is beginning to define a research question. It lists the phases of an action research project so that participants can make their preliminary research plans and discuss them with each other and with group leaders.

Support Structures for the Finding Out Phase

During this phase of the research process, participants examine each others' data, describing what they see; look for patterns in the data; help to clarify each other's research focus, and deal with issues generated by the process of the research itself. The third phase of the cycle is devoted to a more thorough analysis of the data each teacher has gathered over the course of the year. Part of our meeting time is spent supporting participants in identifying findings in their data and in writing reports about what they have learned.

A key support process used repeatedly during this phase is group data analysis. Once a participant has gathered a substantial amount of data, the collegial group has a strong role to play in providing insight about analyzing the data. The data may consist of printouts of one students' programming projects gathered over a period of time; copies of many students' programs; transcripts of interviews with students; a set of teacher's notes; students' self evaluations; videotapes; a set of test papers or surveys; or whatever the researcher has gathered for analysis. A complete set of the data is distributed to group members for review. Sometimes, the researcher has a clear idea of what she is looking for and is asking for confirmation: "I think this collection of procedures shows that students are collaborating with each other. Can you help me trace some of the ideas that students might have borrowed from or taught to each other?"

At other times, a researcher may find the data confusing and ask for help finding a focus: "I've had my students draw up contracts for how they will resolve problems that occur when they are working together at the computer. After one round of programming projects was completed, I had the students review their contracts, answer questions about how well the contracts had worked in resolving any disputes that occurred, and make new contracts for their next round of projects. But I can't tell if their second set of contracts is any different than the first. Can you help me see whether or not the students have become more sophisticated in how they think about working together?"

In all cases, insights from the group have stantially added to a researcher's understanding of her own data -- although, as in other processes used during the year, the final analysis, based in the data, is the researcher's own. She is responsible for using or ignoring any of the insights which emerge from the group.

The writing process is the least developed aspect of our action research work. This may be partly because each participant has to expose her process, her findings and her writing abilities, first to other group members, and possibly to readers beyond the group. Or perhaps we haven't yet understood the process well enough to develop appropriate scaffolding for this part of the research cycle. One intervention used by several group leaders during the 1990-91 year was to start writing and editing as part of the project startup rather than waiting until the research is all but complete.

Two structures are used to support writing during the Finding Out phase. One structure provides support for writing in progress. Participants share copies of their preliminary drafts. A set of common guidelines is provided for peer editors which allows group members to be as supportive as possible to each other. Peer editors provide the first audience for the piece and begin by identifying the strong points in the writing, as well as any points which need additional clarification, documentation or reorganization. The goal is to help each participant communicate as effectively as possible about the purposes for their research, the methods that they used, and their findings. Peer editing takes place in one-on-one conferences, small group feedback or whole group author's circles. Another structure is an Action Research Report Planner which serves as a preliminary outline and probes the planning for the final research reports.

Evaluation Methodologies

Evaluation of the 1989-90 action research cycle.

Formative evaluation of our project during the 1989-90 cycle focused primarily on documenting the professional development of the teachers who participated, and assessing the effectiveness of the particular strategies used for supporting the teachers' action research. An external evaluation component carried out by The Regional Lab for the Northeast and the Islands included pre-post interviews with teachers, and administering a pre-post Stages of Concern Questionnaire. Data gathered by the project staff included videotapes or audiotapes of each research meeting; session-by session evaluation forms completed by participants; leaders' notes; and participants' notes, journals, planning documents, data gathered by teachers and research reports written by teachers.

An interim formative evaluation report on the 1989-90 action research cycle written by a team of external evaluators from the Regional Laboratory for the Northeast and the Islands, focused on the professional development of LARC participants (Loucks-Horsley and Drexler). The report focused on four major goals for project participants:

- development of skills and understandings associated with classroom action research and use of that research to inform teaching
- development of strategies for reflecting on their teaching practices
- development of collegial relationships with other participants
- contribution to the knowledge of other educators through written reports, presentations and workshops

The report from the Regional Lab concluded that participants had developed skills and understandings associated with classroom action research, and as a result, were looking more closely at <u>how</u> their students learned Logo. All reported that they had changed

aspects of their teaching as a result of examining their own practices and sharing ideas with colleagues. Teachers also reported that they had specific ideas about what they would look for next year to document and support their students work. The report also cited collegial sharing as one of the strongest features of the project, from the point of view of participants. As a consequence of participating, all but one participant wrote research reports for eventual publication by the project; several submitted reports of their research, and other articles related to their teaching to local professional newsletters and to national professional journals. Finally, six of the eight participants who completed the 1989-90 cycle were planning to continue with the project: four of them served as group leaders or co-leaders for the 1990-91 cycle in their own districts; two continued as teacher researchers. [The other two changed positions. One became a school administrator for a school which is a pilot site. The other moved to an independent school and is no longer a Logo teacher. She has undertaken a small action research project on her own about student use of spell checkers.]

Evaluation of the 1990-91 action research cycles at nine long-distance sites

Evaluation of the 1990-91 action research groups had a more complex set of objectives and was conducted primarily at a distance:

- We were interested in learning about the professional development of participating teachers.
- We wanted information about the support required for leaders of action research groups.
- We wanted to understand the value of the project for participating teachers, leaders and school districts.
- We needed information on the usefulness of particular structures and methods with recommended revisions and additions.
- We hoped to identify what it would take to make this type of activity self-sustaining.

The data we used for the evaluation included videotapes of leadership institute sessions and evaluations by leadership institute participants; background questionnaires completed by teacher participants; copies of meeting agendas, minutes, and support structures used at each site; notes of phone conversations with group leaders; teachers' research questions, plans and written reports; questions and information shared on the telecommunications network; pre-post telephone interviews with two teachers at each site; the report of a focus group at which leaders reported on the progress, successes and concerns at each site; and a written evaluation by each group leader.

Questions about professional development

In order to find out about the professional development and nourishment of participating teachers our interview questions probed to find out:

- What research questions did teachers investigate? Were they able to carry out the whole process: developing research questions, gathering and analyzing data, and writing up and sharing their research with others?
- Writing has been a particularly difficult component of the process for previous groups. How important is writing for participants, and what expectations, collaborative processes and support from leaders are effective in facilitating writing by teachers in the project?

• What changes do participants make in their teaching practices or the ways in which they conceptualize their work during the course of the project? Have they incorporated any of the specific processes modeled in LARC seminar meetings into their teaching practices?
• Although Logo instruction is not part of the project design, do participants learn more about various aspects of Logo during the project?
• How important is collegial support to participants? How do they share their work with colleagues in their LARC groups, in their schools and school districts, through publications, or through conference presentations?
• How is this form of teacher enhancement different from more conventional forms, such as faculty meetings, graduate courses, or in-service training workshops?

Questions about the support needed by seminar leaders

In order to find out about the materials and practices used by seminar leaders, and the support needed by seminar leaders, our phone conversations and focus group questions dealt with issues such as:

• How effective was the leadership institute in preparing group leaders? What changes should be made for future leadership institutes?
• How did seminar leaders use and modify processes and materials developed by project staff and modelled during the leadership institute? What types of materials were developed or adapted by seminar leaders to supplement project materials?
• What support was useful to group leaders themselves? How important is communication among sites and between sites and project staff. In particular, what are the relative values of telephone, mail and electronic teleconferencing?
• What types of support and acknowledgement do groups and leaders receive from local school administrators, university personnel, resource people at different times during the year?

Our final report, planned for release in January 1992, will report our findings about the above questions.

Outcomes we have observed and documented in our pilot research cycles

From the two pilot cycles (1986-87 and 1989-90) we can document the following types of professional development outcomes:

• teachers developed more sophisticated knowledge of Logo content and of what their students were learning;
• teachers learned and carried out action research practices, including following two students, formulating questions, making research plans, gathering and interpreting data, submitting research reports for group editing, and potential publication;
• teachers changed their classroom practices as a result of specific action research findings, other reflective practices and collaboration with colleagues;
• most participants in the 1989-90 action research cycle continued to participate as teacher researchers or took on leadership roles for the 1990-91 cycle;
• some wrote new district curricula, presented at conferences and submitted articles for publication.

Through direct involvement in research -- formulating questions, observing, documenting, gathering a variety of data and making sense of it -- teachers gained

insights about the teaching and learning in their own classrooms. At the same time, they came to recognize and respect their own and their colleagues' ideas, experience and expertise. Furthermore, from ideas shared by colleagues and/or modelled by the leaders, they acquired a greater variety of pedagogical strategies.

As teachers gained knowledge about individual students they developed wider repertoires of specific ways to support the learning of particular students. They became more aware of different learning styles and cultural diversity. In the process, they discovered that Logo learning was not necessarily linear. It was frequently messier than they had expected. Thus, they developed a greater appreciation for the types of strategies needed to support open-ended problem solving and project development.

Here are some examples of ways that action research led to changes in classroom teaching practices. The names of teachers and students involved have been replaced by pseudonyms.

• During his first year as a Logo researcher, Donald, a fourth grade teacher, followed students whose Logo work puzzled him. The research meetings gave Donald a way to reflect on his work with a group of colleagues and the suggestions made by his colleagues helped him to find new strategies for supporting his students. Kathy was a tentative learner who did not seem to be making progress or to benefit from his instruction. Jerry was an extremely quick learner, but was resistant to help from a teacher, preferring to use only his own ideas, even when he was stuck. Donald felt that both students were missing important learning opportunities. He brought examples of both students' work to the research group, and asked for feedback about the issues that were puzzling him. After a session in which we looked at one of Kathy's programs in great detail identifying the Logo knowledge she was and was not using, Donald was able to tailor some direct interventions that helped Kathy make what seemed to be remarkable process during the next few months. After a similar session focusing on Jerry's work, Donald learned to provide some input to Jerry indirectly by giving ideas to a classmate within earshot, or leaving a resource book open to a particular page -- since Jerry usually resisted direct interventions but was receptive to information he overheard or found.

• While working with Kathy and other students who were having difficulties solving problems geometrically, Donald came to a deeper understanding of the importance of the "Rule of 360" or the "Total Turtle Trip" -- the fact that a series of turtle commands which bring the turtle back to its starting point always involves a total rotation which is an exact multiple of 360 degrees. He was then able to incorporate this knowledge into his teaching, supporting his students in planning and debugging their designs for geometric shapes.

• Barbara was a computer specialist in an elementary school, who taught large numbers of students in a computer lab each day. Her teaching approach stressed whole-class lessons followed by individualized problem-solving at a computer. Her students were required to remain in their seats, and were not allowed to bring pencils, notebooks or other objects into the computer lab, or to speak to other students during their working time. As part of her research, Barbara focused on a problem she had communicating with students whose first language was not English and who could not understand her instructions. One approach she used was to pair one of these students with a partner who spoke his language, but who understood more English. Later she decided to pair all the students in one particular "experimental class." She also allowed students to get out of their seats during class and walk around to see what other students were doing. As a result of participating in research, Barbara gave herself and her students permission to

work in a way that allowed students to learn from each other, rather than just from the teacher.

• Phyllis was also a computer specialist in an inner city middle school who taught large numbers of students each day. She was concerned about students in a large sixth grade class who did not seem to be learning effectively, who seemed to need her attention constantly, and who engaged in disruptive or non-productive behavior an unacceptably large percentage of the time. Initially, Phyllis explained the situation by referring to the students' socio-economic and family problems, to the timing of the class just after lunch hour and to the large number of students.

Phyllis decided to work on creating a supportive classroom atmosphere as her research focus. She posted technical information at several places in the classroom so that students would not have to rely on her as much. More significantly, she began to identify certain students as potential Logo helpers, and to make helping each other and learning from each other a specific goal for her students. She explicitly legitimized the sharing of ideas among students. Her research data included interviews she designed to ask students about getting and giving help, and sharing ideas with other students. The process of surveying her students about sharing created a focus in her class. She also kept copies of students programming projects so that she could trace the sharing of ideas from student to student. By the end of the year she reported a great deal of sharing among groups of students, as documented by their work, and was able to compare this with students attitudes towards cooperation as revealed by their interviews. Finally, the classroom atmosphere had changed. Disruption and waiting impatiently for the teacher's attention had been replaced by a calmer, more productive ambience.

• Darlene wanted her fourth and fifth students to learn to use variables and recursion, but she was unsure about whether they could understand the concepts involved. She kept detailed anecdotal notes about her own teaching of one fourth grade class. She recorded her teaching interventions, what she said, her students' comments and questions, and the Logo examples they produced over a period of a few months. During the course of her research, Darlene came to understand that a recursive procedure call -- in which a procedure calls a copy of itself as a subprocedure -- is a fundamentally different concept than simple looping she'd envisioned. Therefore she needed a different type of metaphor to make this distinction clear to herself and her students. She read articles on the subject, and adapted them for use in her classroom. Finally, she used her detailed notes to develop a curriculum to teach all her fourth and fifth grade students to use variables and recursion. She has submitted an article for publication based on her experiences.

• Bill taught science and mathematics as well as Logo to two classes of sixth grade students in a team teaching situation. His investigation focused on the processes by which sixth grade students learn to use variables. His original intention was to introduce the use of variables to his most mathematically able students. He developed a number of open-ended challenges to support this learning, and to his surprise, found that all his sixth grade students were capable of completing them, when given appropriate support. He subsequently integrated these new challenges into his ongoing curriculum.

• Gabrielle was concerned about grading and evaluation for her sixth grade Logo students. Her action research focused on developing explicit expectations and grading criteria in consultation with her students. For each project, she developed an outline of the particular Logo skills and strategies to be used, and of the value to be associated with each one. In this way she was able to develop a system of grading that made her learning expectations explicit, that allowed her to add new skills and expectations to the

evaluation criteria for each new project, and that was perceived as fair by her students because they had helped her create it.

The use of subprocedures to break a difficult problem into separate, clearly defined and more manageable parts is one of the powerful problem solving tools built into Logo. Paul was concerned that his sixth grade students were not using subprocedures effectively, and instead were writing long undifferentiated programs which were difficult to read and debug. Furthermore, once they had completed a project to their own satisfaction, they were reluctant to edit their procedures to make them conceptually clear. As part of his research, he tried an alternate approach. Instead of asking his students to create their own designs from scratch, he gave them copies of another student's program, which was incomplete and difficult to understand. He challenged them to edit the procedure to make it more readable and to complete the project. In the context of this challenge, Paul found that his students were able to use subprocedures and focus on some of the ideas that Logo was designed to help students learn.

The examples we have cited indicate some of the ways that participants in the Logo Action Research Collaborative used the action research process to identify needs in their own classroom practices, to bring those needs to the group for collaborative support, to make changes in their teaching and to document the effects of those changes.

We observed that teachers who participated in the process of researching their own practice, became more flexible, more effective teachers. They also became more authoritative, articulate spokespersons about what their students were learning, and more able to justify the choices they made as Logo teachers. Some experienced teachers entered the project thinking they knew everything they needed to know to teach Logo effectively -- one had taken three graduate level Logo courses. After a year as classroom researchers the same teachers realized that they had a lot more to learn about teaching and learning with Logo. And they had a number of strategies to continue learning, and collegial support to help them do so.

The ramifications of the project extended beyond the participants' classrooms. Six teachers who participated in the pilot research cycles took on leadership roles for the 1990-91 cycle. Several worked on revising their districts' Logo curricula to include more important content and processes. Several designed and led workshops for district teachers. Three teachers published articles in the newsletter of the Boston Computer Society's Special Interest Group on Education. Two others submitted work to national professional journals, The Computing Teacher and The Logo Exchange. Several teachers appeared on 1991 programs at the Lesley College Conference on Computers in Education, The New England Association of Teacher Educators, and The National Educational Computing Conference. These represent professional contributions which extend beyond what is traditionally considered a teacher's role.

Concluding Comments

The Logo Action Research Collaborative has developed a process to support research by classroom teachers. The process has been carried out successfully by groups of teachers and local leaders at nine sites. Support for the process includes a one-week Leadership Institute for research collaborative leaders and a loose leaf notebook of support materials for adaptation and revision; a monograph on Assessing Logo Learning (Watt and Watt, in press), a monograph of teachers' research reports on Logo Learning, and an assessment report that will support its replication in other settings. The last two publications are scheduled for release in early in 1992.

In our pilot research cycles we have observed that project provides professional nourishment and collegiality for experienced teachers, that teachers gain new understandings about the Logo content they are teaching and their students are learning; that teachers make self-directed improvements to their classroom teaching practices; and that teachers take on new roles as researchers and research group leaders. We are gathering data and will report at a later date about the professional development of teachers who participated in the national sites.

We anticipate that the action research approaches and support structures developed by this project are applicable to a broad range of content domains. We are currently seeking collaboration with other educators to use the methodologies we have developed for collaborative research groups with content focus other than Logo.

"... More and more teachers are demonstrating that, given reasonable opportunities and professional support, they can maintain their enthusiasm for teaching. The key for them is to continue finding ways to be productive learners, reestablishing their roles as curriculum-makers as well as reservoirs of wisdom about classroom practices and children's learning... Two assumptions have been basic to these directions: The qualities of teachers' understandings influences to a large degree what teachers do in their classrooms. The best source for teachers to learn more about teaching and learning, child growth and development, materials and methods is through examination of their own practices."

Vito Perrone. (1978) Supporting Teacher Growth, The Action Research Reader

Acknowledgements

We would like to acknowledge the support we have received for this work from the National Science Foundation and Education Development Center, under NSF grants MDR 8651600 and TPE 8855541. We acknowledge the contributions of our collaborative teacher researchers and research group leaders: Gerri Abrams, Elizabeth Berrner, Lorita Brockington, Sheila Cory, David Crump, Diana Freedman, Chris Held, Doreen Kelly, Robert Kondel, Peter Lavelle, James MacNeil, Jane Manzelli, Jack McKiernan, Mary Miller-Teehan, Pasquale Puleo, Judith Randolph, Marian Rosen, Donna Rosenberg, Kitsy Rothermel, Patricia Rowe, Doris Tyler, Phyllis Victorson and Nan Youngerman. We also want to thank our research and evaluation associates and consultants: Nancy Drexler, Jan Ellis, Claryce Evans, Joan Funk, Jan Hawkins, Susan Loucks-Horsley and Roy Pea. The views expressed in this paper, however, are strictly those of the authors and do not necessarily reflect the views of the National Science Foundation, Education Development Center or any of our collaborators.

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